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**HAZARD EVALUATION AND TECHNICAL ASSISTANCE REPORT
HETA 89-128-L2085
UNITED STATES DEPARTMENT OF EDUCATION
CHICAGO, ILLINOIS
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**Hazard Evaluations and Technical Assistance Branch
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I. INTRODUCTION

This report presents the results of the National Institute for Occupational Safety and Health (NIOSH) Health Hazard Evaluation (HHE) at the U.S. Department of Education (DOE), 401 S. State Street, One Congress Center, 7th Floor, Chicago, Illinois, on May 18-19, 1989. The information presented will include NIOSH's evaluation of the site, the data collected, interpretation of the findings, and recommendations.

The survey at DOE was conducted in response to two separate requests for an indoor air quality investigation in February 1989, one from Illinois Senator Paul Simon and one from a group of Department of Education (DOE) employees (confidential). Several employees had reported stale air, low or high humidity, headaches, eye irritation, fatigue, sore throats, persistent coughs and chest tightness, and respiratory problems which they attributed to their office work environment.

A preliminary site visit by NIOSH investigators to One Congress Center was conducted on March 27-28, 1989, to meet with the management and employee representatives and to plan the protocol for the evaluation. A follow-up survey was conducted on May 18-19, 1989 to conduct the environmental monitoring and a questionnaire survey.

II. BACKGROUND

The United States Department of Education in Chicago, Illinois (Region 5), leases office space on the 7th floor of an eight-story building in downtown Chicago. Built in the late 1800's, the rectangular shaped cast iron reinforced masonry structure has windows which cannot be opened. The current owner purchased the building in 1984 and installed a heating, ventilation and air-conditioning (HVAC) system (new coils, ductwork and air handlers) in September 1987, one month prior to DOE becoming the 7th floor tenant. Presently, in addition to the DOE, the building houses a cafeteria, the State of Illinois Employment Security Department (which rents the bulk of the office space in the building), and the Illinois Peoples Gas Company.

The type of work performed at DOE (word processing, typing, filing, photocopying), is typical of most office environments. The Department of Education is usually in operation Monday through Friday from 7:30 a.m. to 5:30 p.m.

At the time of the NIOSH investigation there were approximately 1800 employees who worked on all eight floors of One Congress Center. The number of workers employed with the Regional Department of Education Office in Chicago has declined from 600 in September 1983 to 220 at present (approximately 90 male & 130 female).

Office Operations and Layout (Building Characterization):

A sketch of the floor plan for the 7th floor is included as Figure 1. The six story Washington Library, the largest municipal library in the United States, is under construction (started in 1988 and is due for completion in 1992) on State Street, just west of One Congress Center. A restaurant is across the alley from One Congress Center, at the rear of the building. At the east end of the 7th floor are eight elevators. The breakroom on the 7th floor and the fire-exit hallway are both used as smoking areas. The total building floor space totals nearly 450,000 square feet and the seventh floor has about 50,000 square feet of space.

Air is supplied to the 7th floor offices through ceiling diffusers and is returned to the HVAC system via return air vents also located on the ceiling, either adjacent to the supply-air diffusers or at the perimeter of the fluorescent light fixtures (approx. 2 ft. x 4 ft.). The building is heated and cooled by a computerized electronic energy management system which pneumatically controls the HVAC forced-air ventilation system. The primary heating needs are met by a gas-fired boiler located in the basement, which provides steam for the heating coils in the air handling units and hot water for the perimeter reheat variable air volume (VAV) units. Supplemental heat for the perimeter offices is provided via an electric resistance baseboard heating system. Three chillers, located on the roof, provide cooling for the building air-conditioning system. The HVAC system is neither equipped nor designed to provide humidification. However, some office employees use their personal portable fans and humidifiers at work.

The north and south halves of the building are on two separate air handling systems. The mechanical equipment for the HVAC system consists of two 30,000 cubic feet per minute (CFM) air handlers at the southeast and northeast corners of the building on each floor. There are 70 to 80 VAV boxes per floor, and each VAV (Mitco or Kruger) box is controlled by one thermostat. Each VAV box distributes air to between one and five supply air diffusers. In variable air volume systems, the air volume distributed to the office(s) varies with space heating or cooling load requirements. The restrooms and elevator lobby areas are serviced by a constant volume air handling system which exhausts directly to the roof with no recirculation. The space above the false ceiling (common plenum) is the return air system for each floor (with

the exception of dedicated exhausts for bathrooms and the elevator lobby areas). Common outside air supply ducts span the width of the building and supply the HVAC systems on each floor. Outside air is supplied through pneumatically controlled vertical dampers located along the alley side facing east on floors two through eight. The exhaust outlets on the second through eighth floors are also located along the alley, parallel to the fresh air intake ports. Depending on the outdoor temperatures, it is reported that a minimum of 25% fresh outside air (75% recirculation) and a maximum of 100% fresh outside air (no recirculation) is drawn into the HVAC systems. The 100% fresh outside make-up air typically occurs with outside temperatures between 40°F to 60°F and the 25% minimum fresh outside air usually occurs with temperature extremes (e.g. below 30°F and/or above 72°F). A computer-controlled economizer (enthalpy) system allows automatic adjustment of the outside air dampers.

Rollamatic® fabric-type filters are used in the HVAC systems. The filters are inspected monthly and reportedly are replaced by the building engineer on an as-needed basis (e.g. when the pressure drop across the filter exceeds 1/2 inch water gauge), or at a minimum, every six months. These filters are positioned at the vertical fresh air intake on the HVAC systems located on every floor.

Reportedly, the lease the Government Services Administration (GSA) has with the building's owner states that the temperature maintained during the heating season will be 65°F to 68°F, and for the cooling season, 78°F to 80°F. According to the owner's representative, the HVAC system typically is operational from 5:00 AM to 6:00 PM. However, comfort-related temperature complaints have been made from employees arriving early (before 7:00 AM) and remaining late (after 7:00 PM). Most offices on the 7th floor have wall thermostats which, unlike the majority of wall thermostats throughout the building, do not have lockable thermostat plastic cover boxes. In addition, the wall thermostats have limiters which restrict temperature settings below 70°F.

Prior to moving to One Congress Center in September 1987, the DOE leased office space on Wacker Drive in downtown Chicago. The former office space reportedly was located in a more "scenic" part of downtown Chicago, had better access to parking facilities, and was preferred by several DOE employees when compared to One Congress Center. The former leased office space was much greater in size than One Congress Center (five floors in a 35 story building verses one floor in an eight story building).

III. EVALUATION CRITERIA

NIOSH investigators have responded to approximately 800 complaints of indoor air quality problems in a wide variety of settings. The majority of these investigations have been conducted since 1979,

paralleling the "energy efficiency" concerns of building operators and architects.

Commonly, the symptoms and health complaints reported by building occupants have been diverse and not suggestive of any particular medical diagnosis or readily associated with a causative agent. A typical spectrum of symptoms has included headaches, varying degrees of itching or burning eyes, irritation of the skin, including rashes, sinus problems, dry and irritated throats and other respiratory irritations. The workplace environment has been typically implicated because workers' symptoms reportedly disappear when they are away from the office.

The causes of comfort and health problems related to indoor air quality are typically multifactorial, which makes determination difficult. The investigations NIOSH has conducted have been classified by the primary type of problem found: inadequate ventilation; contamination from inside the building; contamination from outside the building; microbiological contamination; contamination from the building materials; and "unknown." The predominant problems identified in the NIOSH indoor air quality investigations can be placed into the following three general categories listed in order of decreasing frequency: inadequate ventilation, chemical contamination, and microbiological contamination. Inadequate ventilation, a category which includes shortages of outside air, poor distribution, and short circuiting of supply air, is reported most commonly in the NIOSH building investigations (greater than 50% of the cases). These ventilation problems make it difficult to control heating and cooling, and allow the accumulation of contaminants in the occupied space. The resulting conditions may cause occupants to become uncomfortable or experience adverse health effects.

Standards for indoor air quality in office buildings do not exist. NIOSH, the Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygienists (ACGIH) have published regulatory standards and recommended limits for occupational exposures.¹⁻³ With few exceptions, pollutant concentrations observed in the office work environment fall well below these published occupational standards or recommended exposure limits. The American Society of Heating, Refrigerating, and Air-Conditions Engineers (ASHRAE) has published recommended building ventilation design criteria, and thermal comfort guidelines.^{4,5} Scientists suspect that work related complaints may be attributable not to individual environmental species, but to the cumulative effect resulting from exposures to low concentrations of multiple pollutants, and work environments outside of comfort ranges.

The basis for monitoring carbon dioxide, temperature, relative humidity, and respirable suspended particulates are presented below:

A. Carbon Dioxide

Carbon dioxide is a normal constituent of exhaled breath and, if monitored, can be used as a screening technique to evaluate whether adequate quantities of fresh air are being introduced into an occupied space. The ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality,⁴ recommends outdoor air supply rates of 20 cubic feet per minute per person (cfm/person) for office spaces and conference rooms, 15 cfm/person for reception areas, and 60 cfm/person for smoking lounges, and provides estimated maximum occupancy figures for each area.

Indoor CO₂ concentrations are normally higher than the generally constant ambient CO₂ concentration (range 300-350 ppm). When indoor CO₂ concentrations exceed 1000 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected. Elevated CO₂ concentrations suggest that other indoor contaminants may also be increased.

B. Temperature and Relative Humidity

The perception of comfort is related to an individual's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperatures. Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. ANSI/ASHRAE Standard 55-1981 specifies condition in which 80% or more of the occupants will find the environment thermally comfortable.⁵

C. Respirable Suspended Particles (RSP) and Inhalable Particles (PM₁₀)

In contrast to fibrogenic dusts which cause scar tissue to be formed in lungs when inhaled in excessive amounts, so-called "nuisance" dusts are stated to have little adverse effects on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. The nuisance dusts have also been called (biologically) "inert" dusts, but the latter term is inappropriate to the extent that there is no dust which does not evoke some cellular response in the lung when inhaled in sufficient amount. However, the lung-tissue reaction caused by inhalation of nuisance dusts has the following characteristics: (1) the architecture of the air spaces remains intact; (2) collagen (scar tissue) is not formed to a significant extent; and (3) the tissue reaction is potentially reversible.

Respirable suspended particles (smaller than 2.5 micrometers) are associated with combustion source emissions. The greatest contributor to indoor RSP is environmental tobacco smoke (ETS).⁶ In buildings where smoking is not allowed, RSP levels are influenced by outdoor particle concentrations with minor contributions from other indoor sources. In buildings with oil, gas, or kerosene heating systems, increased RSP concentrations associated with the heating source may dominate.

Although there are no established criteria for exposure to airborne total particulate in office buildings, as a guideline, the Environmental Protection Agency (EPA) has an ambient air quality standard for respirable particulate matter (PM₁₀ standard, 150 ug/m³ for 24 hours). PM₁₀ concentrations (particles smaller than 10 micrometers in diameter) combine combustion, soil, dust, and mechanical source particle contributions. The larger particles are associated with outdoor particle concentrations, mechanical processes, and human activity. When indoor combustion sources are not present, indoor particle concentrations generally fall well below the EPA ambient PM₁₀ standard.

IV. EVALUATION METHODS

A. Environmental

A detailed sampling protocol was developed and implemented for One Congress Center. Since the numbers of workers and offices at DOE were relatively small, all the 7th floor offices were monitored for relative humidity, temperature, respirable particulates and carbon dioxide. Measurements were recorded throughout the DOE offices on May 18, 1989. The monitoring and analytical procedures used in this survey included:

1. Temperature and Relative Humidity (RH).

Real-time temperature and relative humidity measurements were conducted using a Vista Scientific, Model 784, battery-operated psychrometer. Dry and wet bulb temperature readings were monitored and the corresponding relative humidity determined via the manufacturer supplied curve.

2. Carbon Dioxide (CO₂).

Real-time CO₂ levels were determined using Gastech Model RI-411A, Portable CO₂ Indicators. This portable, battery operated instrument monitors CO₂ (range 0-4975 ppm) via non-dispersive infrared absorption with a sensitivity of 25

ppm. Instrument zeroing and calibration were performed daily prior to use with zero air and a known CO₂ span gas (800 ppm). Confirmations were conducted throughout the instrument use period.

3. Respirable Suspended Particulates (RSP):

Real-time RSP concentrations were measured using GCA Environmental Instruments Model RAM-1 monitors. This portable, battery-operated instrument measures changes in particle concentrations via an infrared detector, centered on a wavelength of 940 nanometers. Indoor air is sampled (2 liters per minute) first through a cyclone preselector which restricts the penetration of particles greater than 9 micrometers. The air sample then passes through the detection cell. Operating on the 0-2 milligram per cubic meter (mg/m³) range with a 32 second time constant yields a resolution of 0.001 mg/m³.

B. Medical

Employees at the Department of Education completed an anonymous, self-administered questionnaire in which they detailed the extent, frequency, and severity of health complaints experienced while employed at this building. Complaints described in the questionnaire ranged from irritant symptoms of the eyes, nose, and throat to comfort and environment factors affecting the temperature and humidity at the employee's work station.

Questionnaires were distributed to employees at their desk in each of 10 rooms on the 7th floor of this building. Completed questionnaires were sealed in envelopes and collected at central locations within departments. Participants were asked how often during the last year and last week (while working at the Department of Education) they experienced symptoms described in the questionnaire. Participants could respond one of five ways: never, rarely, sometimes, often, or always. In addition, participants were asked if the symptom usually improved, stayed the same, or worsened, when they were not at work.

Health related responses reported by workers were divided into symptom groups: Indoor-air quality (headache, runny nose, stuffy nose, dry eyes, burning eyes, sore throat, fatigue, and sleepiness) and respiratory and flu-like symptoms (cough, wheezing, shortness of breath, chest tightness, fever, and aching muscles). To be tabulated for consideration, a respondent had to answer "often" or "always" to the symptoms in the specific symptom group. Each symptom group was further refined to determine the extent to which

these symptoms could be related to working conditions. Employees were asked if the symptoms they experienced improved when away from work or on vacation. An answer of "yes" provided additional support to the contention that a symptom or complaint was work-related.

V. RESULTS

A. Relative humidity, Carbon dioxide, Respirable Particulates and Temperature

The CO₂ concentrations on the 7th floor were well below 1,000 parts per million (ppm), a guideline which NIOSH investigators use to determine the adequacy of the ventilation in an office work area (see figures 3 and 4). The ambient CO₂ concentration outside the office building along State Street (heavy automobile traffic throughout the day and several bus stops) averaged 475 ppm.

All office areas surveyed were within the ASHRAE guidelines for both temperature and RH (see figures 5-8). The ASHRAE "comfort chart", a range considered to be both comfortable and healthful, lies between 73 and 77°F and 20 to 60% RH (see figure 2).

The concentrations of respirable particulate matter, measured with a direct reading aerosol monitor, ranged from 54 to 1160 micrograms per cubic meter (ug/m³) (see figures 9 and 10). Except for the smoking areas, particulate concentrations on the 7th floor were below 150 ug/m³. The highest respirable particulate concentrations (1160 and 644 ug/m³) were measured in the smoking areas (fire-exit hallway and the breakroom, respectively) on the 7th floor.

The office windows throughout the building cannot be opened, thus increasing the reliance on the ventilation system to supply and circulate fresh air and to exhaust contaminated air.

There may be an intermittent problem with reentrainment of exhaust air from the businesses located adjacent to DOE. A few of the DOE employees stated that they occasionally detected unusual odors in their offices which some attributed to restaurants within or nearby the building, maintenance activities (painting, woodworking, etc.) on the 7th floor, the library construction project across the street, and exhaust fumes from the loading dock area.

B. Medical

One hundred forty-one workers (65% of the work force), completed questionnaires. The mean age among participants was 41 years (range 21-66). Fifty-eight percent of the participants were

female. The level of education among respondents ranged from "some high school" to graduate/professional degree (9th-11th grade, 0.7%; high school graduate, 14%; some college or an AA degree, 30.0%; bachelor's or technical degree, 18%; some graduate training, 15%; and graduate/professional degree, 21%).

Table I summarizes the percentage of workers who responded "Often" or "Always" to a symptom and also indicated that the symptom improved when away from work. These combined responses are considered to be a better indicator of a work-related effects. The 10 symptoms reported most often were: dry eyes 32.6%, stuffy nose 29.8%, sleepiness 29.1%, fatigue/tiredness 28.4%, sore eyes 27.7%, dry throat 26.2%, chills 25.5%, burning eyes 24.1%, sneezing 22.0%, and headache 19.9%. Analysis to determine if the room location affected symptom patterns showed no trend or association by room.

Responses categorized by indoor-air symptom group, showed that 46 persons (32.6% of the respondents) had one or more of these symptoms occurring "often or always" which improved when away from work. Twenty-eight persons (19.9%) were affected by headaches, 26 persons (18.4%) were affected by runny nose, 42 persons (29.8%) had a stuffy nose, 46 persons (32.6%) had dry eyes, 34 persons (24.1%) had burning eyes, 9 persons (6.4%) had a sore throat, 40 persons (28.4%) were fatigued, and 41 persons (29.1%) were sleepy (see Table II). Room assignments were not found to affect a workers risk of experiencing one or more symptoms in the indoor air group.

Twenty-one (14.9%) were affected by one or more of the symptoms in the respiratory and flu-like symptom group (RFLS) (Table III). Additionally, 9 persons experienced 3 or more of the 6 RFLS group, suggesting that 6.4% of the workers at this work-site may be experiencing building-related respiratory/flu like symptoms (see Table III). The prevalence of building related respiratory/flu like symptoms was not associated with room assignment, gender, level of education, or years worked in the building.

Individual comfort concerns were expressed most often by those wishing to adjust the air movement around their work station (65.9%). Fifty-six percent (56.7%) of the participants wanted to adjust the temperature, 39% felt the room was too hot, and 36.8% felt the room was too cold. Poor air movement was described by 55.3%; 53.2% said the room was too dry, and 32.6% considered their room too dusty.

When asked about a typical workday, employees indicated that the overall physical environment remained the same throughout the day (56.7%); 34.8% said that conditions became worse during the day, and 2.8% said that conditions improved. Workers felt that the

symptoms they experienced reduced their ability to work at least sometimes during the last year (never 23.4%, rarely 22.7, sometimes 38.3%, often 8.5%, always 0.7%). These symptoms caused 37.6% of the respondents to stay home at least sometimes (never 29.8, rarely 19.9, sometimes 37.6, often 5.0). When asked which season affected them the most, employees indicated the seasons in the following order: No seasonal variation, Winter, Spring, Fall, and Summer.

Employees were asked if they believed that they had allergies to common allergens. Seventy-six percent (76.6%) considered themselves allergic to animals, 62% to pollen and plants, 61% to molds, and 50% to dusts. These levels are higher than what would be expected in the general population.

Eighteen (12.8%) rated the lighting at their work station as "too dim," 29.1% rated it "a little too dim," 42% considered the lighting "just right," 10.6% rated the lighting "too bright," and 2.1% felt the lighting was "much too bright."

When asked about the comfort of their chair, 55.3% said it was "reasonably comfortable," 25.5% said "somewhat uncomfortable," and 15.6% indicated that their chair was "very uncomfortable."

VI. DISCUSSION

A. Environmental

The NIOSH survey revealed a condition of elevated airborne particulates (more than 150 ug/m^3) in the smoking areas, which may be a nuisance to some employees. Environmental measurements showed that temperature and RH levels were within the ASHRAE guidelines, however, it is possible in some situations the guidelines may not be met, and people on the 7th floor may experience some degree of discomfort. Several of the workers complained of what they perceived to be frequent overheating or overcooling of the offices. When questioned, several workers thought that the heating/cooling systems did not have a mechanism for making adjustments in the temperature of the air and others did not think that this adjustment was very effective. The CO_2 data suggest that this space was adequately ventilated on the day of the survey.

The perception that there were problems with the indoor environment at DOE may have been due in part to a concern for energy costs to operate the facility. Methods often used to combat high energy costs include attempts to minimize the infiltration of cold air in the winter and hot air in the summer and reducing the amount of

fresh air, which requires conditioning, taken in by the air handling systems. These and other methods can result in an inadequate amount of fresh air and/or temperature and humidity levels outside of comfortable limits in office spaces.

B. Medical

Building related health complaints have been the subject of intense study since the early 1970's. Health complaints among building occupants have been given varying names such as "Tight Building Syndrome," "Sick Building Syndrome," and "Building-Related Illness." These names have been interchanged in the scientific literature and the popular press, causing considerable confusion. In an effort to resolve some of this ambiguity over indoor air quality and the description of associated health effects, two terms describing building related effects have emerged, "Sick Building Syndrome" and "Building-Related Illness."

Sick Building Syndrome is characterized by a variety of non-specific symptoms chiefly eye, nose, and throat irritation, sensation of dry mucous membranes and skin, mental fatigue, headaches, erythema, hoarseness, wheezing and cough, nausea, and dizziness. These symptoms generally improve when the individual leaves the work environment. Inherent in this definition of Sick Building Syndrome is the lack of an identifiable causative agent, although the term implies an unproven and unlikely etiology to unexplained symptoms. In contrast, Building-Related Illness involves a recognizable building source of the illness which generally results in allergic reactions, skin diseases, or infections.

In a study of over 4000 office workers in Denmark, the most common building related symptoms included lethargy (57%), blocked nose (47%), dry throat (46%), and headache (46%).^{8,9} However, the symptoms observed at the Department of Education offices in Chicago also included irritant effects of the mucous membranes of the eyes, nose, and throat. Some of the symptoms reported at the DOE offices are consistent with those reported in the Denmark study, but the pattern of symptoms is actually somewhat different.

Studies to characterize indoor air quality and thereby establish who may be at risk for developing symptoms have shown that women tend to be affected more frequently with more symptoms than men, and smokers appear to be affected more so than non-smokers.¹⁰ Temperature extremes tend to aggravate problems within buildings. Worker satisfaction and stress have also been associated with symptom prevalence.

Our evaluation of the Department of Education Offices was designed to summarize the extent and frequency of symptoms among workers and to determine if a pattern of occurrence could be observed.

Over 30% of the workforce at this building complained of work related symptoms. The symptoms experienced by workers at DOE are commonly reported in indoor air quality evaluations. Since responses to our questionnaire were submitted anonymously, we have no means available to identify individuals for further follow-up. It may be advisable for persons who are continuing to be affected by respiratory or flu like symptoms to be evaluated by their personal physician.

Approximately 76% of the respondents indicated that they believe themselves to be allergic to animals and to a lesser extent pollens, plants and dusts. These results are considerably higher than would be expected in the general population. Whether or not these individuals are actually allergic to these materials is not known. Additionally, a reason to explain why such a high percentage of the workforce believes that they are allergic to these materials is not known.

The questionnaire also addressed employee concerns about comfort. The perceived lack of air movement around the desk of 65% of the respondents indicates problems with air circulation on the 7th floor of this building. Fifty six percent (56%) complained about the temperature at their work station.

It should be noted that the 63% response rate in this evaluation is low and limits any meaningful conclusions about the extent of building-related illness or problems with ventilation within the DOE departments. Symptoms, however, were distributed throughout the seventh floor and were not associated with specific rooms, job titles, or length of employment.

VII. CONCLUSIONS

Based upon the results of the questionnaire, at least nine persons may be experiencing work-related symptoms at the Department of Education. Measurements indicated a problem with the control of airborne particulates in the smoking areas.

Questionnaire responses indicated that, although measured temperatures and relative humidities were within recommended comfort ranges, the occupants were not comfortable at their workstations. While direct airflow measurements were not made, it is probable that, due to rearrangement of office space (moved walls, added partitions), changes

in the ductwork servicing the seventh floor may have unbalanced the ventilation system, causing inadequate airflow in some areas of the floor. Since the vertical exhaust and intake air vents are located parallel to one another along the alley at the rear of the building, the possibility exists for reentrainment of exhaust air, and that the fresh make-up air could be "polluted." Building management should consider relocating the fresh air intake vents to preclude this from occurring.

VIII. RECOMMENDATIONS

In view of the findings of the environmental and medical investigations, the following recommendations are made to provide a better work environment for employees.

1. Workers with health problems should consult with their personal physician. The employee should inform the physician about temporal relationships between the symptom(s) and the work environment if they exist, but neither the employee nor the physician should limit consideration of potential causes to the building's physical environment.
2. In order to control the distribution of environmental tobacco smoke, smoking lounges should be provided which are ventilated using ASHRAE-recommended rates (60 cfm/person), with exhaust air vented to the outside. Keep in mind that the ventilation air for these lounges may be provided from other, non-smoking, office environments.
3. The DOE smoking policy should be revised to restrict smoking to areas which have dedicated exhaust systems and are supplied with fresh (preferably outside) air at the rate of 60 cfm/person (based on the maximum number of people who would typically use the smoking lounge). The current smoking policy does not remove the smoke from the building, but rather simply restricts the smokers to certain areas. With this arrangement, the smoke is recirculated into non-smoking areas by the ventilation system, and is a potential contributor to employee complaints.
4. The DOE should hire a ventilation contractor to determine whether the HVAC system, in its current configuration, has balanced airflow, and sufficient outside air provisions (NIOSH recommends using the current ASHRAE guideline of 20 cfm/person for office space). DOE should also consider adding a filtration system for the mixed air (outside air and recirculated air) stream. The VAV System servicing the interior office spaces may not have been designed with minimum stop positions in the VAV distribution boxes. This could cause periods of time with no airflow to a particular

zone. The ventilation contractor should determine the best way to provide minimum airflow through these manifolds at all times. Surveillance should continue to insure that temperature and RH for all offices are maintained within the ASHRAE recommended comfort zones and all office wall thermostats should be equipped with lockable boxes.

5. Some of the offices on the 7th floor have electrical outlets which protruded about three inches off the floor, and were a potential tripping hazard, especially since they are located in the middle of the traffic pattern. The building engineer should consult with an office designer/space planner for proper relocation of the electrical outlets. In addition, current office space planning should be reviewed to optimize employee comfort and work space utilization.
6. Some of those employees interviewed reported smelling exhaust type fumes, reportedly from the loading dock area located along the alley. Since the air intake ports for the building are located on the east side of the building along the alley, it is possible that under some conditions, exhaust from idling delivery trucks enters through the fresh air intakes. Delivery trucks should be required to turn off their engines while in the loading dock area. Building management representatives should also consider the development and installation of a ventilation system that would actively remove and control migration of contaminants from the loading dock area.

If further evaluation or technical expertise is needed to resolve any indoor air problems, on-site assistance is available from the following sources. The expertise, availability and cost of these consultants vary with locality and state.

1. A list of engineering firms certified by the National Environmental Balancing Bureau (NEBB) is available from the NEBB:

National Environmental Balancing Bureau
8224 Old Courthouse Road
Vienna, Virginia 22180

2. A list of industrial hygiene ventilation consultants who are members of the American Industrial Hygiene Association (AIHA) is available from the AIHA:

American Industrial Hygiene Association
345 White Pond Drive
Akron, Ohio 44311-1087

3. Local or state health departments or consulting programs.
4. Ventilation experts should also determine whether the DOE offices can provide comfortable conditions during all seasons. This could include, but is not necessarily limited to, modifications to the HVAC system and/or work spaces and the building structure. Also, the building owners and DOE administrative officials should periodically monitor the IAQ problems employees report to building maintenance personnel (e.g. temperature, ventilation, etc.).

This is the final report of our investigation. In order to comply with our regulations regarding informing the affected employees (CFR, Title 42, Part 85, Section 85.11), DOE management should post this letter in a prominent place, accessible to the employees, for a period of 30 calendar days. Should you have any questions concerning this report, feel free to call NIOSH at (513) 841-4374 for John Decker and (513) 841-4386 for Richard Driscoll.

IX. REFERENCES

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Table I

U.S. DEPARTMENT OF EDUCATION
One Congress Center
Chicago, Illinois
HETA 89-128

Symptoms Reported as Occurring Often or Always
When at Work and Improving When
Away from Work
(140 Respondents)

Symptoms	Persons	Percent
Dry Eyes	45	32.6%
Stuffy Nose	41	29.8%
Sleepy	40	29.1%
Fatigue/Tiredness	39	28.4%
Sore Eyes	38	27.7%
Blurry Vision	38	27.7%
Dry Throat	36	26.2%
Chills	35	25.5%
Sore Throat	33	24.1%
Sneezing	30	22.0%
Headache	27	19.9%
Runny Nose	25	18.4%
Dry Skin	24	17.7%
Coughing	20	14.9%
Pain-Upper Back	17	12.8%
Pain-Lower Back	14	10.6%
Tension/Nervousness	13	9.9%
Pain-Shoulder/Neck	12	9.2%
Feeling Depressed	12	9.2%
Difficulty Concentrating	12	9.2%
Aching Muscles	11	8.5%
Hoarseness	10	7.8%
Shortness of Breath	9	7.1%
Wheezing	7	5.7%
Chest Tightness	7	5.1%
Dizziness	7	5.1%
Pain-Wrist/Hand	7	5.1%
Nausea	6	4.3%
Fever	3	2.8%
Difficulty Remembering	1	1.4%

Table II

U.S. DEPARTMENT OF EDUCATION
One Congress Center
Chicago, Illinois
HETA 89-128

INDOOR AIR SYMPTOM GROUP

140 Respondents

SYMPTOMS	SYMPTOMS OCCUR OFTEN OR ALWAYS WHILE AT WORK	SYMPTOMS OCCUR OFTEN OR ALWAYS WHILE AT WORK AND IMPROVE WHEN NOT AT WORK
	Persons	Persons
Headache	31 (22%)	28 (19.9%)
Runny Nose	37 (26.2%)	26 (18.4%)
Stuffy Nose	62 (44.0%)	42 (29.8%)
Dry Eyes	63 (44.7%)	46 (32.6%)
Burning Eyes	41 (29.1%)	34 (24.1%)
Sore Throat	16 (11.3%)	9 (6.4%)
Fatigue	52 (36.9%)	40 (28.4%)
Sleepiness	51 (36.2%)	41 (29.1%)

Table III

U.S. DEPARTMENT OF EDUCATION
One Congress Center
Chicago, Illinois
HETA 89-128

RESPIRATORY & FLU-LIKE SYMPTOM GROUP
140 RESPONDENTS

SYMPTOMS	SYMPTOMS OCCUR OFTEN OR ALWAYS WHILE AT WORK AND IMPROVE WHEN NOT AT WORK	RESPONDED OFTEN OR ALWAYS TO THREE OR MORE SYMPTOMS
	Persons	Persons
Cough	21 (14.9%)	8 (5.7%)
Wheezing	8 (5.7%)	6 (4.3%)
Short of Breath	10 (7.1%)	7 (5.0%)
Chest Tightness	7 (5.0%)	7 (5.0%)
Fever	4 (2.8%)	2 (1.4%)
Aching Muscles	12 (15.6%)	4 (2.8%)

Legend for Figure I and Graphs

**One Congress Center, 7th Floor
Chicago, Illinois
HETA 89-128**

- A: 700 A Secretary's Regional Representative**
- B: Conference Room**
- C: Office of Civil Rights**
- C LS: Legal Section**
- C RDO: Regional Director's Office**
- D: Student Financial Assistance**
- E: Rehabilitation Services Administration**
- E RCO: Regional Commissioner's Office**
- E CR: Computer Room**
- F: Credit Management & Debt Collection (CMDCS)**
- F-E: Fire Exit/Hallway (Smoking Area)**
- G: Inspector General's Office**
- H-N: CMDCS, North End of Office**
- H-S: CMDCS, South End of Office**
- BR: Breakroom (Smoking Area)**
- I: CMDCS, File Room**
- J: Office of Civil Rights/Law Library**
- K: Student Financial Assistance**
- O: Outside One Congress Center, Near the Corner of State Street and Congress Parkway**

Figure I
One Congress Center, 7th Floor
HETA 89-128

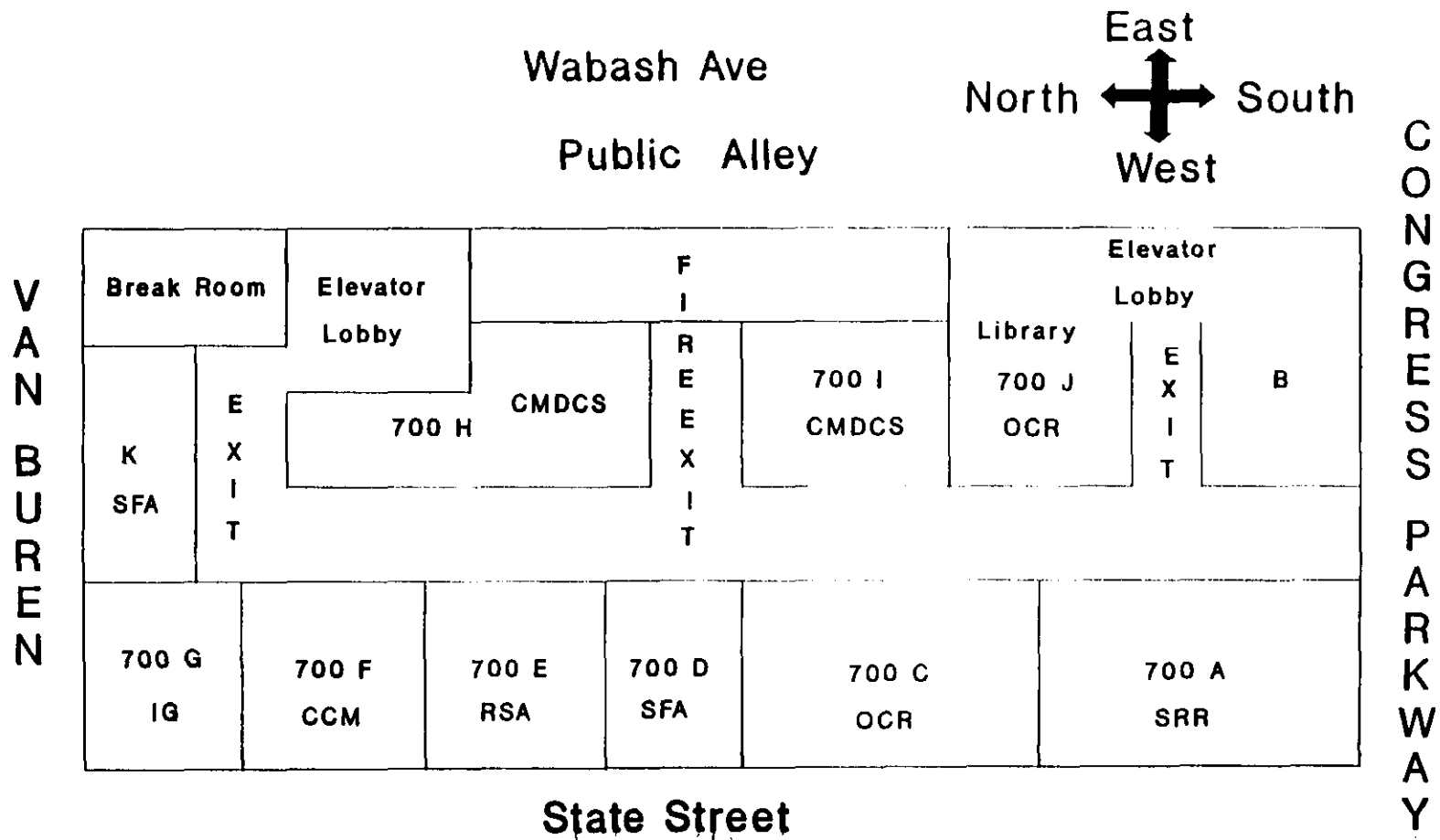


Figure 2

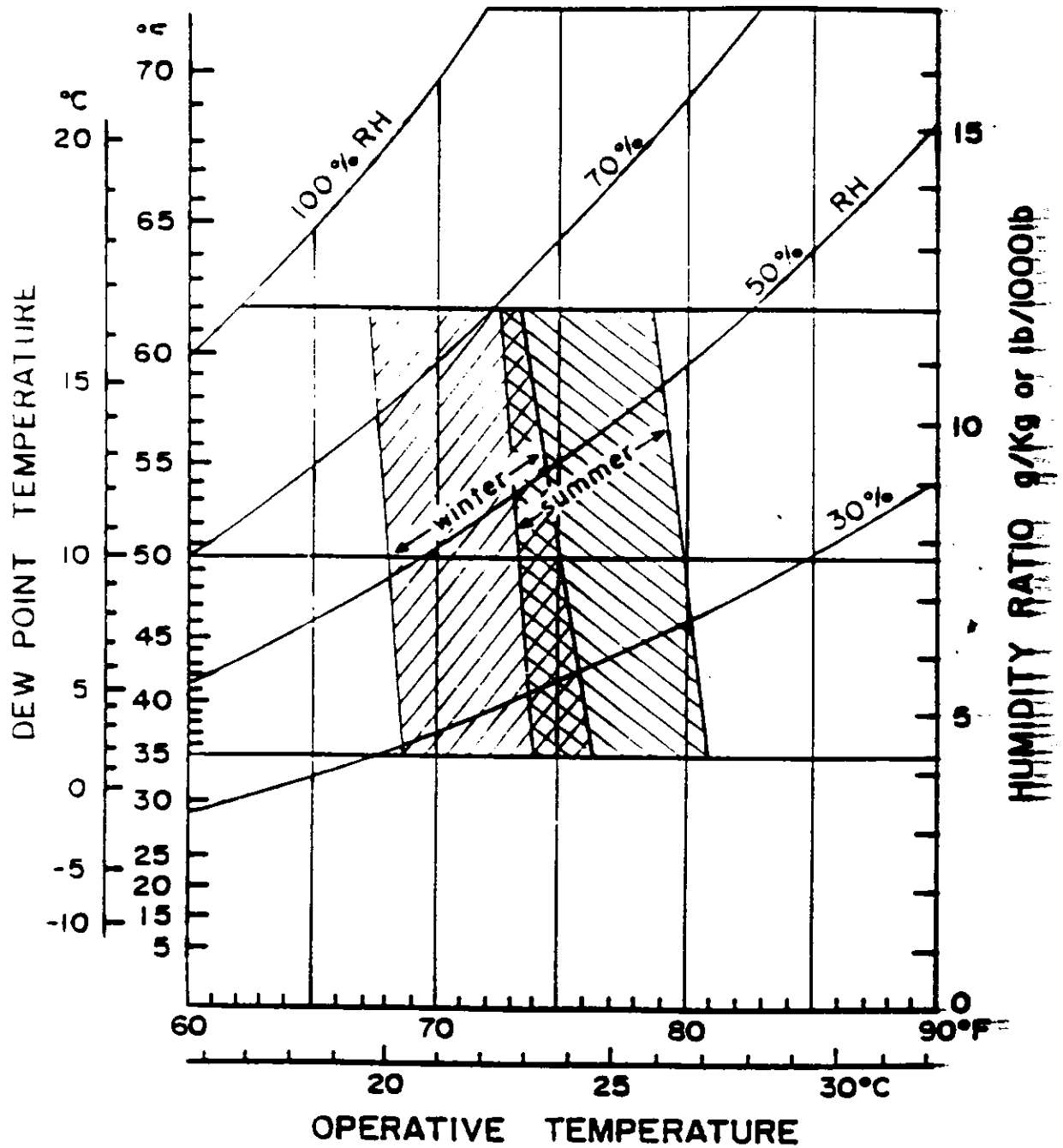
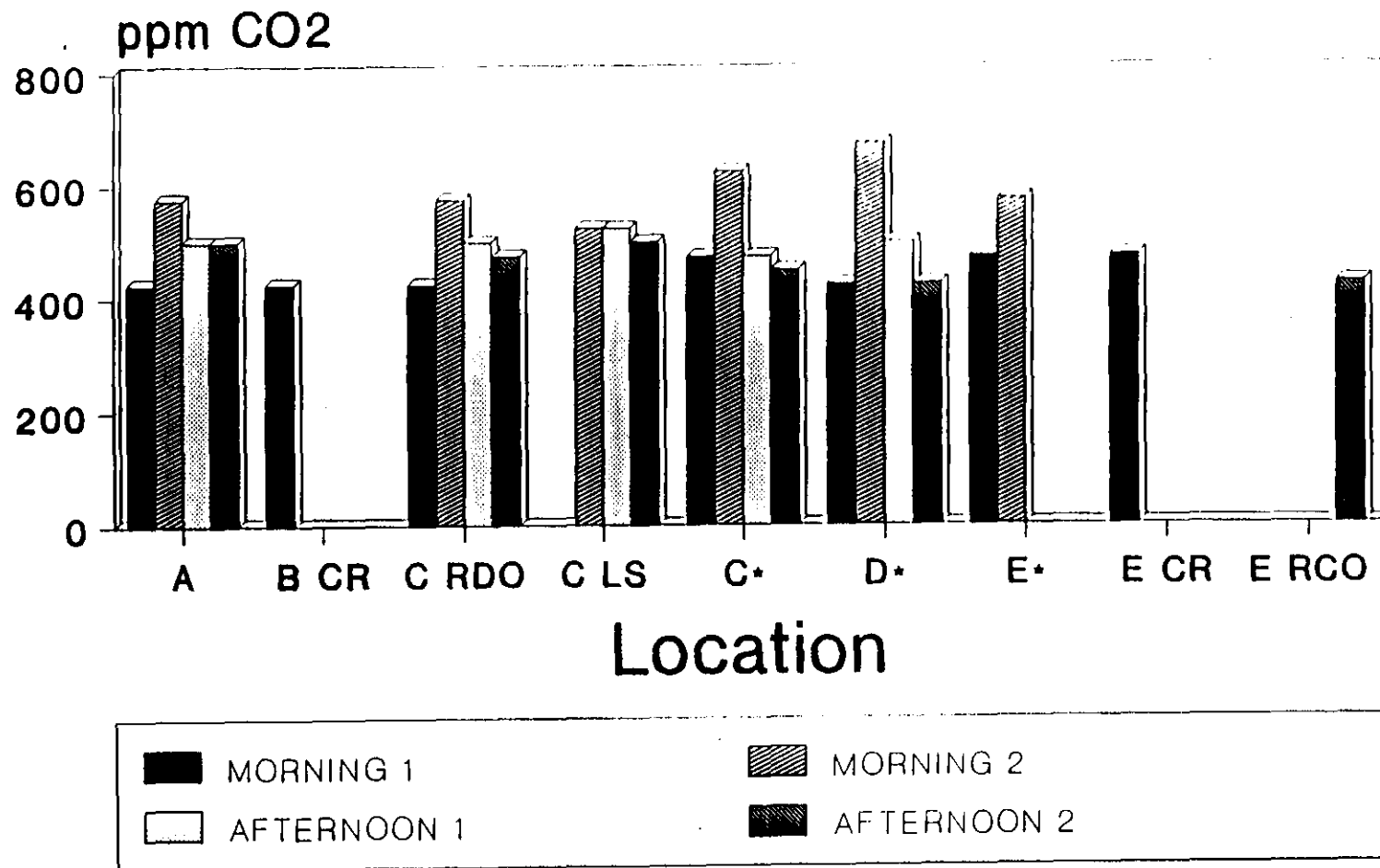


Table courtesy of: The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
 Standard 55-1981, "Thermal Environmental Conditions for Human Occupancy"

Figure 3
Carbon Dioxide Concentrations



* center of room

Figure 4
Carbon Dioxide Measurements

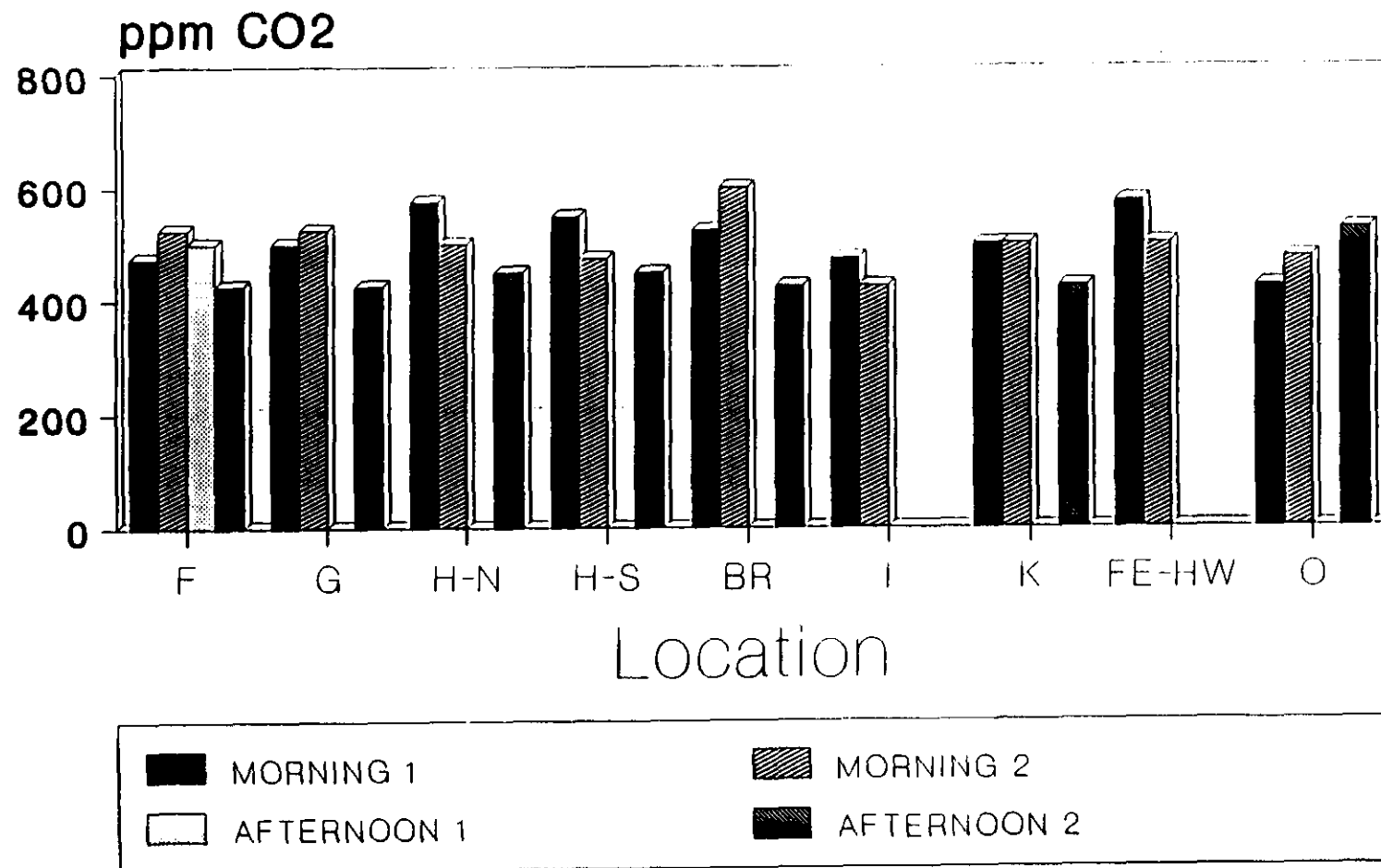
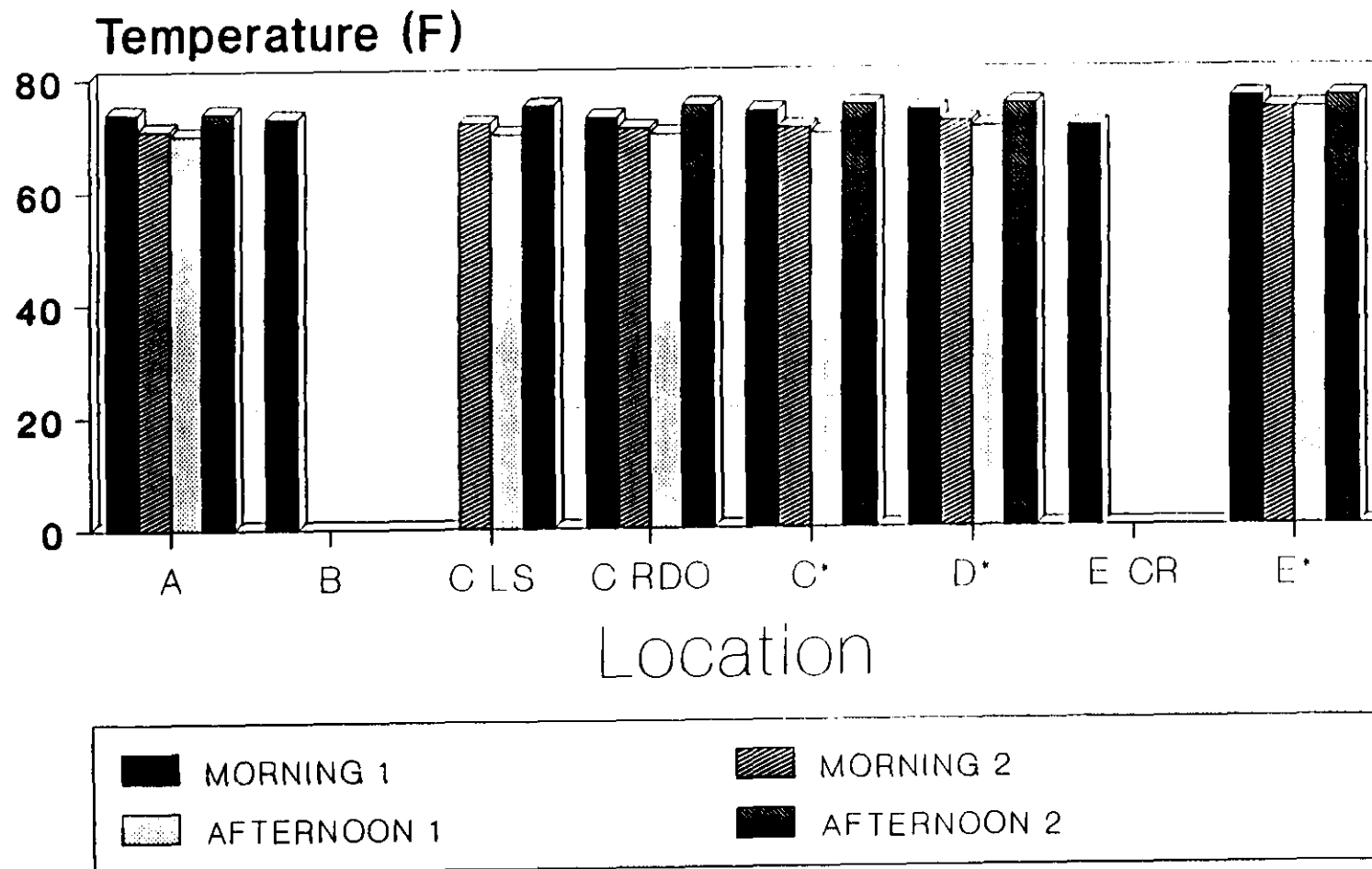
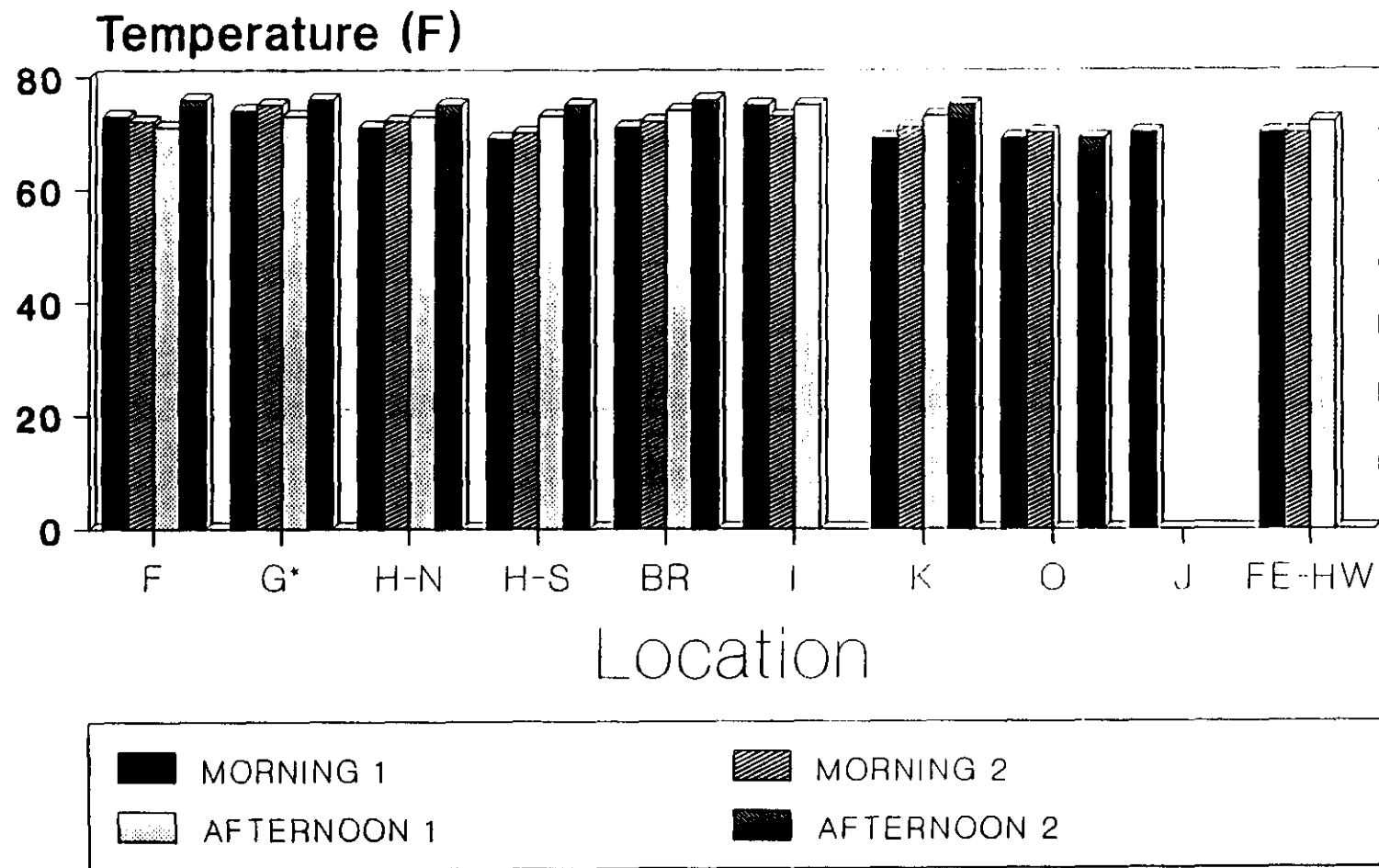


Figure 5
Temperature Measurements



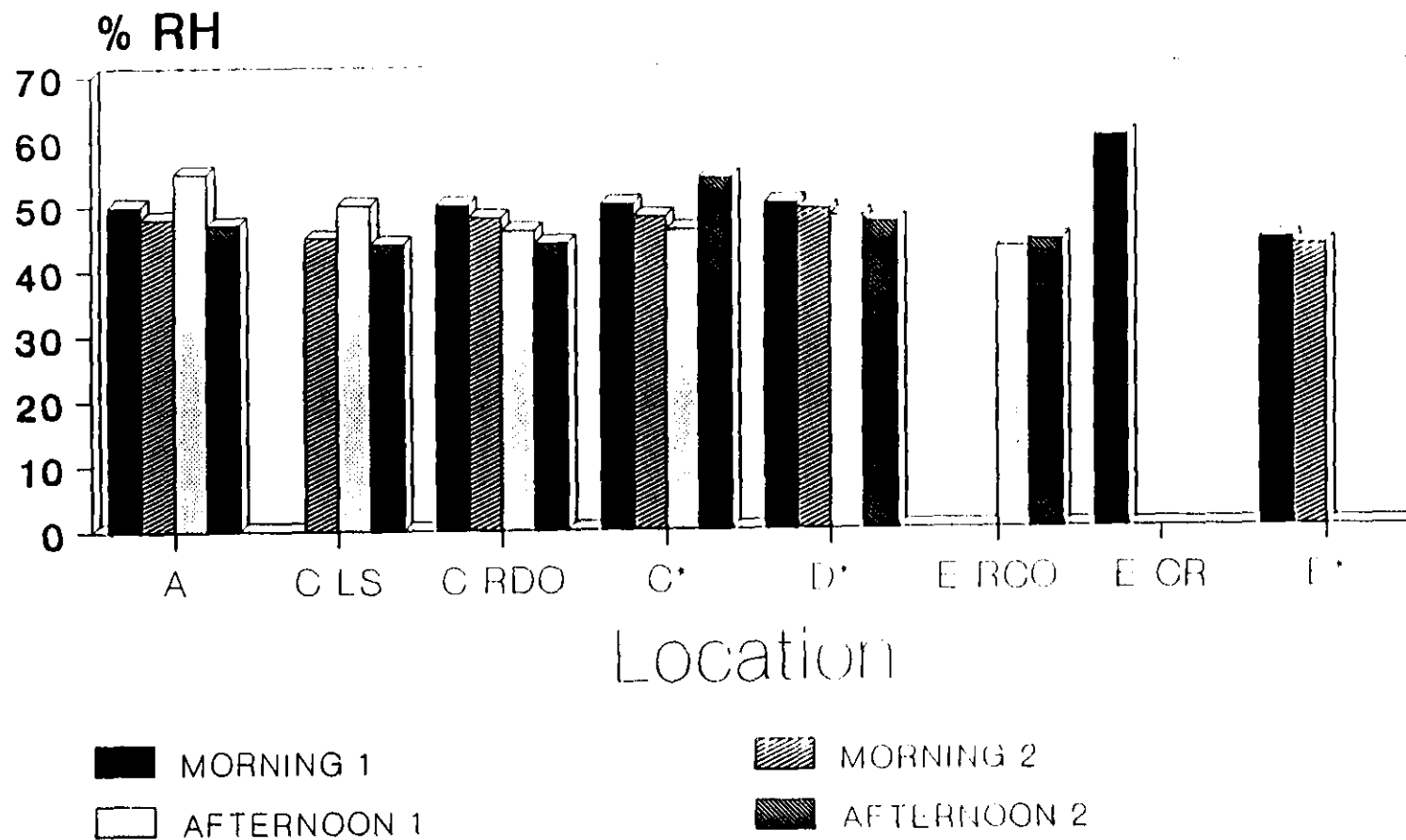
* center of room

Figure 6
Temperature Measurements



* center of room

Figure 7
Relative Humidity



* center of room

Figure 8
Relative Humidity

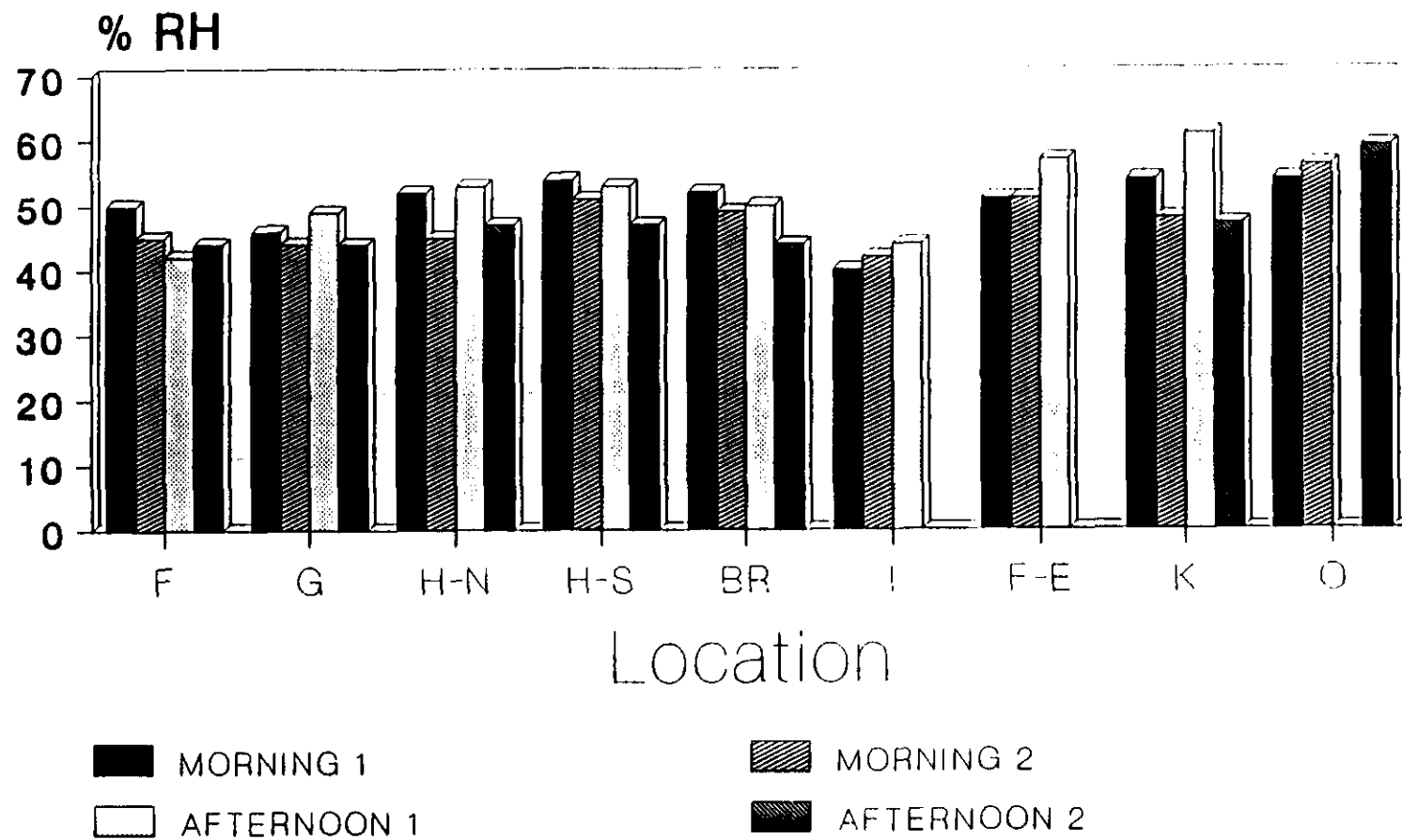
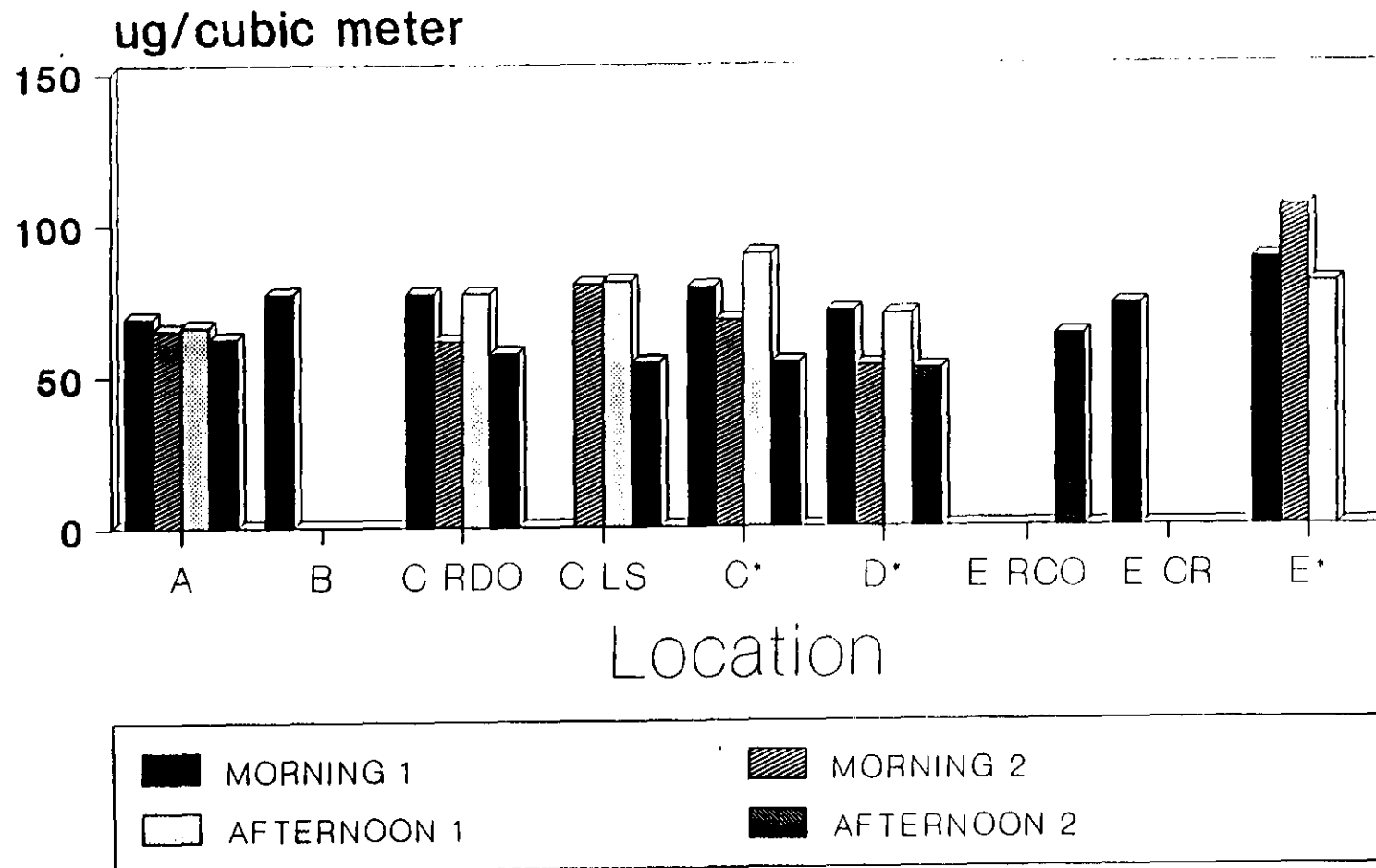
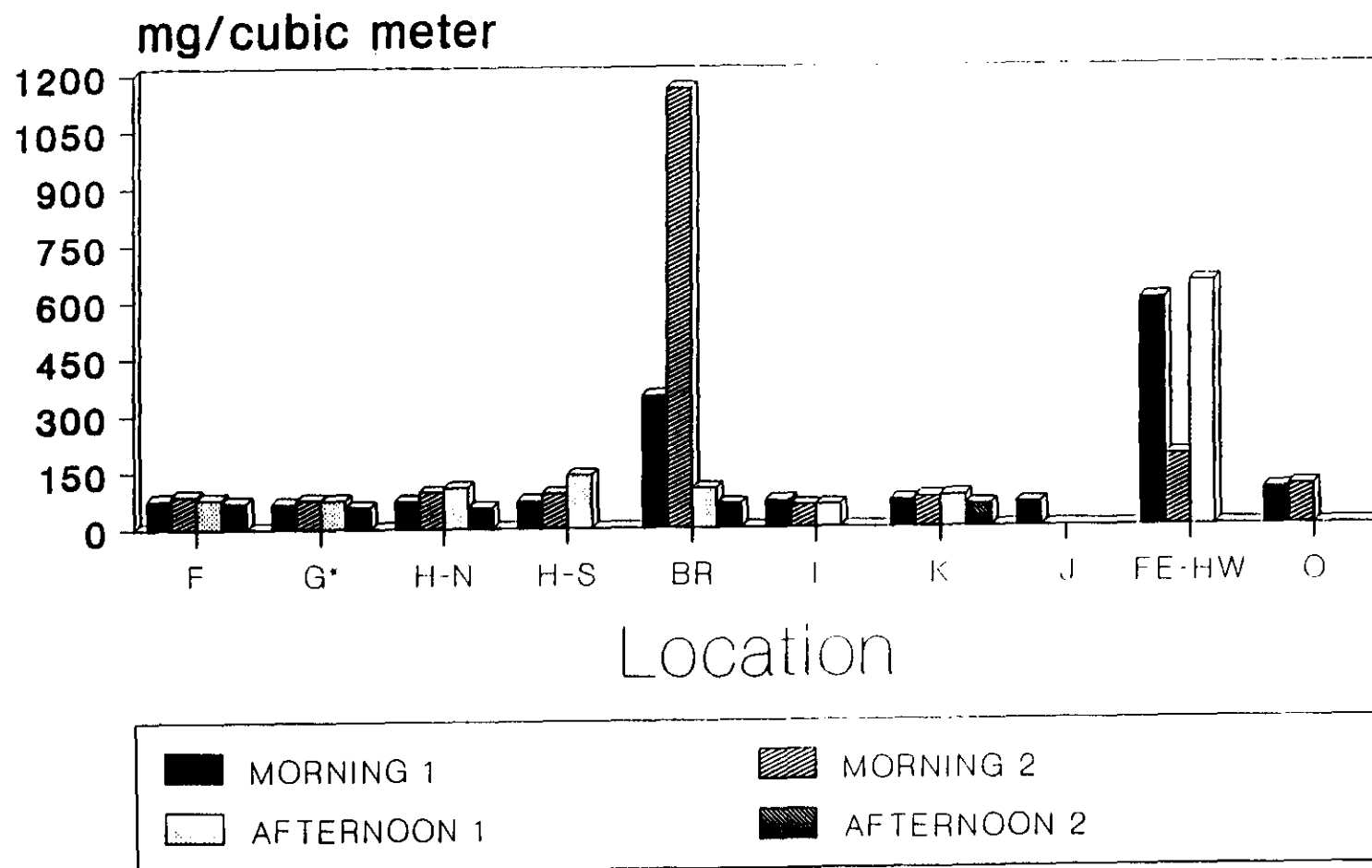


Figure 9
Respirable Suspended Particulates



* center of room

Figure 10
Respirable Suspended Particulates



* center of room